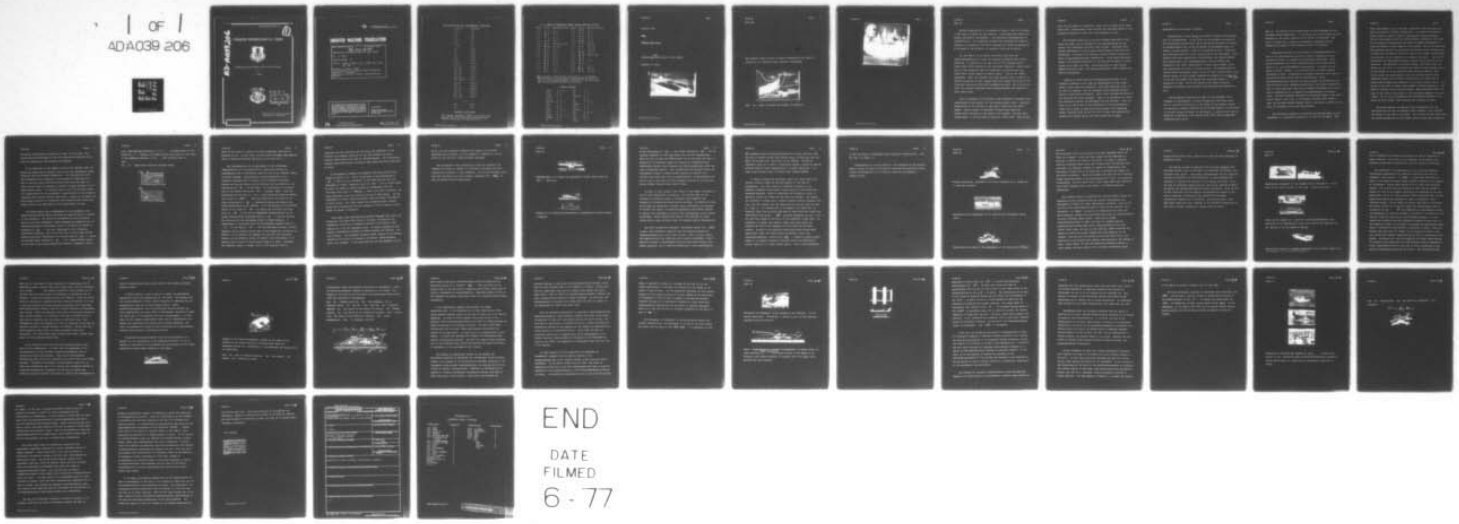
AD-A039 206 FOREIGN TECHNOLOGY DIV WRIGHT-PATTERSON AFB OHIO F/G 13/10
EKRANOPLANS ARE WINGED SHIPS OF THE FUTURE,(U)
OCT 76 D PIPKO
UNCLASSIFIED FTD-ID(RS)T-1432-76 NL

1 OF 1
AD A039 206



END

DATE
FILMED
6-77

AD-A039206

FTD-ID(RS)T-1432-76

DDC
RECEIVED
MAY 11 1977
D

FOREIGN TECHNOLOGY DIVISION

EKRANOPLANS ARE WINGED SHIPS OF THE FUTURE

by

D. Pipko

Approved for public release;
distribution unlimited.

UNEDITED MACHINE TRANSLATION

FTD-ID(RS)T-1432-76 26 October 1976

FTD-76-C-001081

EKRANOPLANS ARE WINGED SHIPS OF THE FUTURE

By: D. Pipko

English pages: 39

Source: Nauka i Zhizn', Nr 1, 1966, PP. 33-41 and 32b.

Country of origin: USSR
This document is a machine aided translation.
Requester: FTD/PDXS
Approved for public release; distribution unlimited.

THIS TRANSLATION IS A RENDITION OF THE ORIGINAL FOREIGN TEXT WITHOUT ANY ANALYTICAL OR EDITORIAL COMMENT. STATEMENTS OR THEORIES ADVOCATED OR IMPLIED ARE THOSE OF THE SOURCE AND DO NOT NECESSARILY REFLECT THE POSITION OR OPINION OF THE FOREIGN TECHNOLOGY DIVISION.

PREPARED BY:

TRANSLATION DIVISION
FOREIGN TECHNOLOGY DIVISION
WP-AFB, OHIO.

RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English
sin	sin
cos	cos
tg	tan
ctg	cot
sec	sec
cosec	csc
sh	sinh
ch	cosh
th	tanh
cth	coth
sch	sech
csch	csch
arc sin	$\sin^{-1}$
arc cos	$\cos^{-1}$
arc tg	$\tan^{-1}$
arc ctg	$\cot^{-1}$
arc sec	$\sec^{-1}$
arc cosec	$\csc^{-1}$
arc sh	$\sinh^{-1}$
arc ch	$\cosh^{-1}$
arc th	$\tanh^{-1}$
arc cth	$\coth^{-1}$
arc sch	sech^{-1}
arc csch	csch^{-1}
rot	curl
lg	log

GRAPHICS DISCLAIMER

All figures, graphics, tables, equations, etc. merged into this translation were extracted from the best quality copy available.

U. S. BOARD ON GEOGRAPHIC NAMES TRANSLITERATION SYSTEM

Block	Italic	Transliteration	Block	Italic	Transliteration
А а	*А а*	A, a	Р р	*Р р*	R, r
Б б	*Б б*	B, b	С с	*С с*	S, s
В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

*ye initially, after vowels, and after ъ, ь; e elsewhere. When written as ë in Russian, transliterate as yë or ë. The use of diacritical marks is preferred, but such marks may be omitted when expediency dictates.

GREEK ALPHABET

Alpha	A	α	*α*	Nu	N	ν	
Beta	B	β		Xi	Ξ	ξ	
Gamma	Γ	γ		Omicron	O	o	
Delta	Δ	δ		Pi	Π	π	
Epsilon	E	ε	*ϵ*	Rho	P	ρ	*ϱ*
Zeta	Z	ζ		Sigma	Σ	σ	*ς*
Eta	H	η		Tau	T	τ	
Theta	Θ	θ	*ϑ*	Upsilon	T	υ	
Iota	I	ι		Phi	Φ	φ	*ϕ*
Kappa	K	*κ*	κ *ϰ*	Chi	X	χ	
Lambda	Λ	λ		Psi	Ψ	ψ	
Mu	M	μ		Omega	Ω	ω	

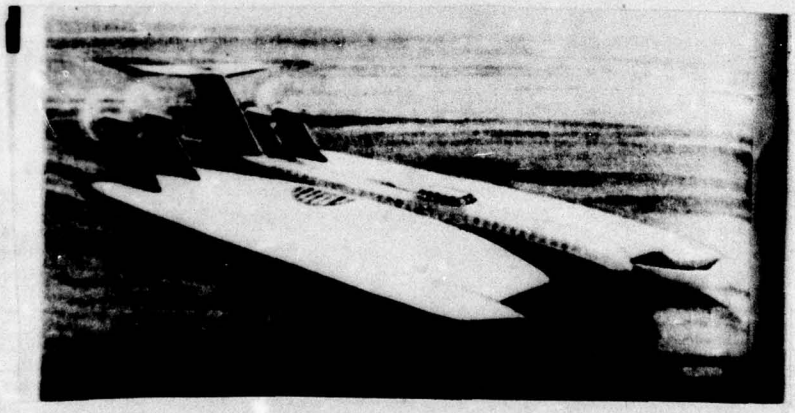
MT/ST-76-1432

~~D409~~

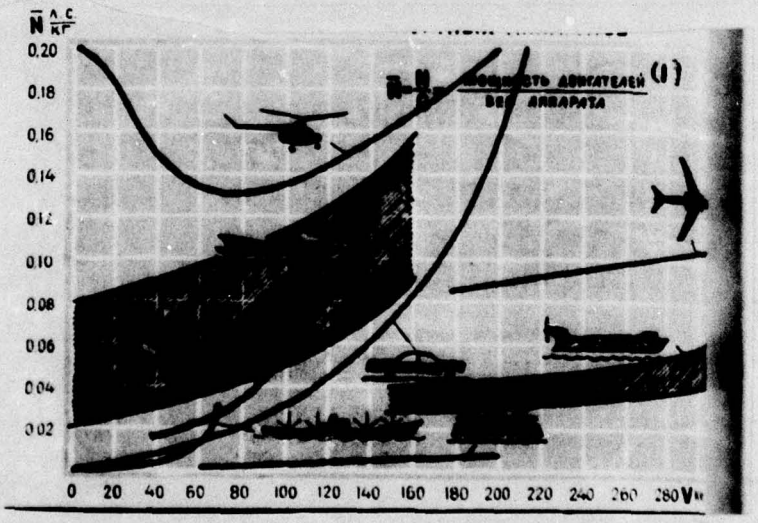
~~SUBJECT CODE D4157~~

3KRANOPLANS-WINGED SHIPS OF THE FUTURE.

Engineer D. Pipko.



The required relative power of engines depending on the speed of motion for are different types transport apparatuses.



Key: (1). Power of engines the weight of apparatus.

Without exaggeration it is possible to skaat', that the transport of the future is equal for the aviation: to avtcstroiteli create the flying hovercrafts, railwaymaces - the expresses, skl'zyashchiye on aerolubrication. But especially vividly this succession of views is visible in an example of the water transport for which the problem of an increase in the velocity is a question "life and to merti".

Nct for whom it is no secret that under onset more the skorostnykhsopernikov of vodny the transport gradually loses bygone pcsitions. It suffices to say that even on the transcontinental lines, where still recently he was considered monopolist, today almost 65o/o of the passengers give the preference of aviation and only remain 35o/o travel aboard of oceanic liners. This is the regular phencmenon: while jet aircraft will bear pasairov with a velocity of 800-900 kilometers an hour, mighty ships they measure the ocean at the "tortoise" velocities into 50-60 kilometers an hour. And to entire by fault the enormous resistance which experience/tests the immersed in water ships hulls.

With an increase in the velocity, this resistance increases first proportional to its square, but then rapidly gathers rate - increases proportional to the velocity in the third, fourth and even fifth degree. Here no longer is necessary to speak about fight for skorost'putem increases in the power of the engines: for this into engine plant, it was necessary to pevratit' entire ship. This is why

only with the advent of hydrofoils, which built up ships hulls above waves crest, ship-builders could overcome the cherished border of the commercial velocity on water into 100 kilometers an hour.

But hydrofoil ships not to end are released from contact with water, but main, with an increase in the size/dimensions of law courts, they noticeably lose their high quality. Therefore their nearest achievements on water routes ship-builders today link with aerokhodami - to ships on air cushion, similar lowered recently to water to pyatidesyatimestnomu "Sormovichu". These flying expresses, capable of developing velocities to 180 and more kilometers in hour, another tol'k enter the life. And nevertheless in them already appeared terrible rival - the winged apparatuses, which obtained the name of ekranoplanov.

Majority of those which are develop/processed today in the different countries of the world of ekranoplanov at first glance differs little from the aerokhodov: will hold them above water all the same air cushion. but the principle of the creation of this cushion already entirely another. And in this the major advantage of the new means for water transport. Here it is appropriate to recall the differences between the helicopter and the aircraft: while the first it is held in air on the thrust/rod of its screw/propeller, which must be equal or more than to the weight of the apparatus itself, aircraft holds in air the lift of wings, and engines they provide only forward motion and their thrust/rod is equal

approximately the e0-evesa of machine.

Approximately so they differ the friend of otdruga and aerokhody with the ekranoplanami: of the first the air cushion is created by the continuously working fans, and of the second the power of engines is expend/consumed only on the overcoming of aerodynamic drag, and cushion (is more precise - lift) it is provided by wing. Hence the same advantages that and of the aircraft before the helicopter: less powerful and heavy dvigatel'ya is installation, the lowered/reduced fuel consumptions, more vysokayapoleznaya load and finally the possibility with other ravsloviyakh to obtain higher flight speeds (see curve/graph n4-y page of colored inset). The design/projected already segodn ekranoplay, figure of one of which is given there, will spsobny accept on board several hundreds of pasazhirov or dozen tone of the load and supply them through the ocean with speeds to 180-220 kilometers an hour. But in the future of the speed of similar machines in printspe they can grow to 300 and even 450 kilometers an hour.

The phenomenon, placed as the basis of the principle of the dvizheiya of ekranoplanov, is known already more than forty years. Even at the glow of aviation, in the middle of the twentieth years, the specialists focused attention on the strange behavior of the wings of aircraft during the motion of the uzemli: in spite of all laws of classical aerodynamics, they created large lift, than at remaining height/altitudes pole/

Page 34. To perceive entire significance of this phenomenon it was necessary almost immediately: it served as one of the reasons for the emergency of the heavy aircraft of the "Terent of Tripleyn". But later a little time in almost so unpleasant a situation with it clashed the designers of the English aircraft to "Suollou".

Light/lung monoplane to the "Suollou" of pednaznachalsya for a sale to the pilot-amateurs and for the sake of simplicity in the piloting is bygone is equipped by sufficiently large wing. This machine possessed fair flight characteristics, but already during tests in it, was reveal/detected disadvantage - it thrust did not desire to make a landing. It is more precise, to make a landing according to rules. Accomplishing technique landing at that time in principle differed little from the contemporary: after maintain/withstanding aircraft in gliding flight in two-three meters from the Earth, pilot gradually geared down to the value by which the lift of wings staovilas' less than the weight of machine, but still it made it possible for it to smoothly sparashyutirovat' to landing strip. Aircraft "Suollou" continued to plan/glide almost to the total loss of speed. Here lift, it is natural, instantly fell almost to zero, and aircraft roughly slapped itself to the earth, causing in the pilot of perception in any way from pleasant.

The "insidious" behavior of aircraft was explained whole by that phenomenon of a unforeseen increase in the lift of the Earth. This

force held machine in air even when, acccrding to all calculations, speed was bygone by clearly insufficient. Is removed this defect is bygone exactly as this is made on contemporary glider/airframes, aircraft they supplied with the landing flaps, allowing for the pilot at the necessary torque/moment was sharp to impair aerodynamics of wing and thereby to force machine to be lowered. But at the same time this precedent forced the scientists and koruktorov more vinimatel'no to study this phenomenon, obtain the name of the "effect of the effect of the Earth", or the "effect of the effect of screen" . lne Tab the theoretical and experimental studies, carried out at the end of the twentieth - the beginning of thirtieth years, they showed that the "effect of the effect of the Earth" was caused by three pinami, by one of the ktorykh it is the appearing under wing air cushion. The driving above the earth/ground or any knoy surface (screen) wing seemingly pressed hearth itself relative wind, and under wing is formed high-pressure area (diagram 1 on 4-1 page colored inset). As a result on the force ΔY whose value depends on flight altitude N - the distance between the wing and the screen. When height/altitude N is equal to the half of wing chord V, lift increment composes a total of 2-3o/o. But if wing is approached the earth/grcund already to one fourth of chord length, then increase will increase to 10o/o.

The given numerals can seem by those incomparable with the size/dimensions of those "trcubles", which supplied to the aviators the "effect of the effect of screen". But the fact is that along with the formation/education of air cushion screen causes even a change in

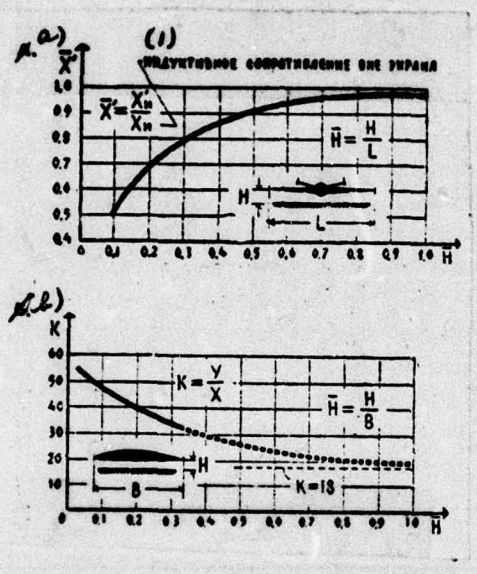
the entire flow pattern of wing of air flow. In this case, also occurs certain uveicheniye of lift and substantially descends drag, which is explained by the following two reasons.

It is known that if the rzmakh of wing is not infinite (but the latter can exist only in theory), then at its ends unavoidably appear !khvosty" from the strongly twisted air - the so-called end visri. The Istochnikm of the emergence of the etikhkh of eddy/vortices is part of the air, which overflows through wing tips from under its lcwer surface where the pressure is higher, by upper (diagram 2 on 4-1 pages colored inset). Tip vortexes serve as one of the basic pichin of a deterioration in the aerodynamic characteristics of real wings in ccmparison with "ideal" infinite-span wings. Screen, as is evident in the diagram, partially "it destroys" these eddy/vortices, which with respect gives to an improvement in the aeyacdinamiki of wing.

The second reason for an improvement in the aerodynamic wing characteristics during motion of screen is connected with the process of lift formation - the latter is accompanied by drag divergence. This part of total resistance x whose emergence is connected with the formation/education of pod'yemncy force, is called of the inductive reactance of $X_и$. The very "mechanism" of lift formation, figuratively speaking, lies in the fact that the wing reject/throws relative wind down, deflecting it to certain angle of ε, called the downwash angle (diagram of 3 cn 4-1 pages colored inset). On the value of this angle depends the inductive reactance: than it

more, that more and resistance. Altitude effect of the flight of H during the motion of wing near screen to the values of the inductive reactance of X'_K and lift-drag ratio of K.

Key: (1). indktivnoye resistance outside screen.



When the wing moves at screen, the latter seemingly reflected the downwash of air. In this case, the rake angle decreases, and together with it inductive reactance decreases to the value of Xw.

The size/dimensions of an improvement in the aerodynamic characteristics in the last/latter two cases just as value of supplementary lift at obrazovani under the wing of air cushion, depend on flight altitude. Specifically, a reduction/descent in the inductive reactance with a decrease in the clearance (distance) between the wing and screen can be evaluated with the pomo'yu of the curve/graph of A to the right. On curve/graph it is evident that if the flight altitude of H composes 0.2 from the spread/scope of the wing of L, then inductive reactance becomes less almost to 80%. Even more boshchim is the given to the right curve/graph of B, constructed taking into account the formation/education of air cushion. On it the pokzano is the altitude effect of the flight of H on value, the so-called lift-drag ratio of K is one of the fundamental characteristics of all flight vehicles. The lift-drag ratio of K - this is its kind the efficiency of the aerodynamic shape of flight vehicles. It pedstavlyaet in itself the ratio of the od"yemncy (useful) force of Y to the drag of X, for the overcoming ktorogo, strictly speaking, and is expended entire work of the dvigate'noy setting up of machine. If we compare, for example, two aircraft with identical weight, but the different values of quality, then better/best, it is natural, will be that of them at whose quality is above: producing the necessary (equal to weight) lift of this aircraft will be

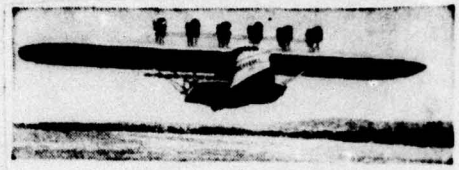
connected with the overccming of less drag, and therefore to this aircraft are necessary they will be the less powerful and heavy engines, which expend less than the fuel/propellant. But furthermore, pleznaya output/efficiency of aircraft with large lift-drag ratio will be above.

Of contemporary passenger the samoletc lift-drag ratio on the average is equal to 18. But if we now look to the curve/graph of б, then it is not difficult to note that with the very low vysotakhkh of flight, components less the 0,1 of the chord length of wing, the effect of screen becomes sc considerable that the lift-drag ratio grows to 40-50. There is nc need to explain, how large advantages would give aviation the use of this effect. but for etogonuzhno to bygone "learn" aircraft, which is called, "to polzat'" at Earth itself. This "but" became that stumbling block, against ktoryy were divide/marked off all attempts to run the "effect of the effect of screen" on aviation.

Even today, when high-altitude aircraft "changed" the fourth ten kilometers, and rockets are fixed to the moon, the layer of the atmosphere, which lies in immediate proximity of the Earth, still remains not tc end the subjugated zone. Of course, helicopters and aircraft successfully overcome it during takeoffs and landings. But cnly overcome. the prolonged low-level flight (flight on low vysoye) requires of the pilots of maximum of attentien, resourcefulness, skill, the courages: is too capricious and cut the dandshaft of our

planet, are too insidious izmennivy the raging of its surface descending and up drafts, too few instants it remains here in the pilcts to the restraint "vzbryknuvshikh" machines.

And nevertheless these difficulties could not eliminate the attempts to utilize an "effect of the effect of screen"; are very tempting tale promised tc them prospects. one of such attempts, true, only with the partial use of an effect, undertook into 1932 to year the German aviation specialists.



Aircraft split to-x during the experimental flight above North Sea (1932 are year).

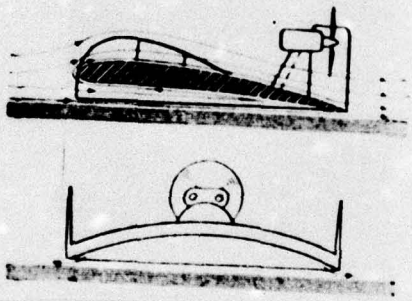


Diagram of the areosleigh-3kranoplana of construction Finnish engineer T. Kaariyu.

On the curve/graph of Δ the flight altitude of H not is randomly compared not with wing chord, but with its spread/scope; whole the fact is that the "destruction" of tip vortexes, but main, a decrease in the downwash angles are observed at height/altitudes considerably greater than necessary for formation/education under the wing of vozdshnoy cushion. this circumstance and blo used during the experimental flights of heavy German seaplane for Dorn'ye to-x: aircraft flew above North Sea at height/altitude of approximately ten meters, and in this case the fuel consumption proved to be less than during flights outside screen (photo above).

In spite of this success, the "effect of the effect of screen" so and not "got accustomed" in aviation. But already then, to the vseredine of thirtieth years, it accepted "upon armament" the designers of ground-based cross-country machines. By pioneers in this area became our compatriot, inventor Pavel Grokhovskiy, who proposed to utilize this effect in apparatus-amphibians, and Finnish engineer T. Kaario, that developed a series of the constructions of the flying areosleighs. These machines and tales by the prototype of those flying ships, ktorye obtained today the sonorous name of ekranoplanov.

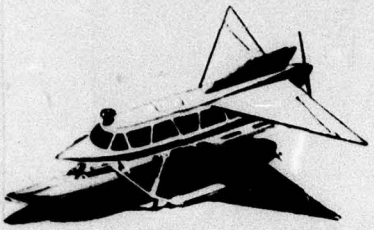
The first areosleigh-3kranoplan, ostroyennye Kaario into 1935 to year, were engineless apparatus with wing-shaped korgusom and "chassis/landing gear" in the form of skis. First in vreya testing the apparatus moved yua buksireye after special areosleighs. Then to machine is bygone is established/installed small piston engine with pusher propeller, and it obtained possibility tc move independently.

This apparatus began acceleration/dispersal cn skis, and then, when the lift of housing became sufficiently large, it blew away from the Earth and slipped above snow cover on air cushion. During the subsequent years of T. Kaaric, constructed another a series of similar machines whose by basic aggregate/unit is bygone "wing-ram" - the wing, using velocity head of relative wind (diagram below).

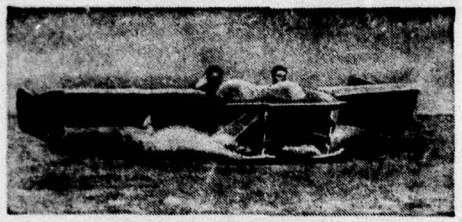
It cannot be said that follcwing twenty five years would pass without leaving a trace lya the developments of the idea of ekranoplanov - for these years the different designers in the different countries would create a whole series cf the already more advanceed machines. Would be undertaken the attempts at least to partially utilize an "effect of the effect of screen": for example the inventors G. Lipman and a. Morozov proposed project azrosaney with wing, the lift ktorogo must was bygone unload rear ski (Fig. on page of 37). But already then it is bygone it is clear that the necessary ffekt wing can give only when it moves above the screen with sufficiently high speed - 150 and more kilometers in hour. For a dry land these mange in any way it is not possible to name safe: the inequality of relief, the stumps, hidder under snow stones and hummocks can lead to the emergency of the sliding of the Earth machine. Perhaps of all developed during many years ground-based apparatuses, which use during motion aerodynamic lifts, only areosleigh-amphibian, created into KB, headed by design project leader A. N. Tupolev, poluchli universal acclaim are constructed seriyno (photo in 4-1 pages colored inset). This is why "originated

in air" the idea of ekranoplanov again replaced "registration": from dry land - to water ....

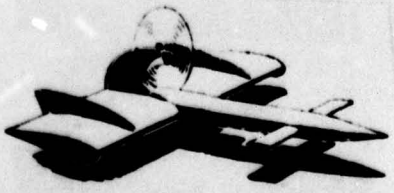
Approximately at the end fiftieth - the beginning of the sixtieth years a series of firms and scientific organizations approached toward serious investigations in the field of producing ekranoplanqv - cceanic liners.



Winged areosleighs, proposed by the Soviet inventors by G. Lipman and A. Morczovs (project).



Experimental boat-3kranoplan of the American firm "Lockheed" during tests.



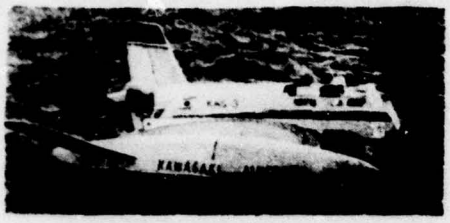
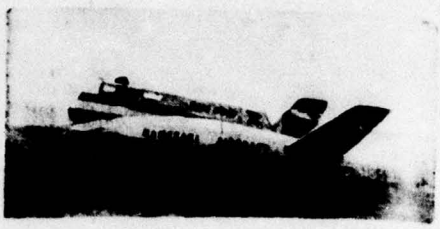
Radio-controlled model of the ekranoplans of the English firm "Collins".

The last/latter tales are selected as the most promising object of study not randomly: large role here played the sad experiment of aviation in mastery by flight of the Earth. In crder to simplify piloting technique winged ships and tc avoid their "collisions" with sea waves, the designers attempt to ensure the sufficiently high altitudes of flight and at the same time tc preserve the "effect of the effect of screen". Above has already been said that the effective flight altitudes depend on the size/dimensicns cf wing - its chord and spread/scope. But this means that to kill those which were indicated "two hares" possible only in one manner - by making large-size ekranoplany.

But, holding course of producing the encrmous flying liners, the designers and the scientists thus far ccnduct investigation and experiments on models and small experimental launchhes. with one of the first such investigations began tc carry out the american firm "Lockheed". In 1962 to year on it constructed that which fly boat-catamaran, equipped with five-meter wing with the airfoil/profile of large curvature (photc above). This wing is bygone established/installed in such a way that its leading edge was arrange/located highly above water, open/disclosing to air free "inlet" under wing, and rear, on the contrary, almost concerned the surface of water and thereby impeded the rapid discharge of air cushion. From the side the outflow of air from under wing it was restricted to two lowered down washers, ikreplennymi on the kntsakh of wing. During tests, the boat was accelerate/dispersed similar to usual launch, and when airfcil lift it became sufficiently large,

housing heaved above water, leaving in it only the screw propeller of suspension motor.

The similar diagram of apparatus with the wing, equipped with kntsevymi washers, used in the model of ekranoplana the English firm "Collins" (Fig. below). This model prednanachalas' for the stability analysis of stability and controllability of winged machines and outwardly it reminded the aircraft of the diagram of "weft" - on to the nose of elongated forward from the wing of the fuselage of model was bygone was established/installed rotary stabilizer. With the aid of this stabilizer and the simplest uprvlyayushchego device in the form of pendulum, automatically was provided the so-called lcngitudinal stability of the machine: in direction nose - tail. When model nosed down down, pendulum it was deflected forward and in this case it turned stabilizer n larger angle of attack.

Experimental ekranoplan of the Japanese firm of "Kavasaki": to the left -vo the time of apron, to the right - during road tests.

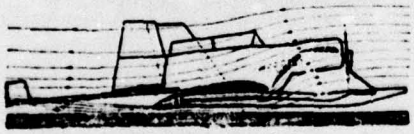



Photo and the diagram of T. Kaario's areosleigh-3kranoplana from povorotnm by the supplementary wing, which ensures the emergence of air cushion at the low speeds of motion.

Hypothetical figure of transport ekranoplana with turbojet engines for the uskreniya of acceleration/dispersal.

Lift on stabilizer increased and returned the ncse of apparatus to normal position. But if ns, on the contrary, it was scored, then pendulum automatically decreased the angle of attack of stabilizer.

The "geography" of investigations in the field of producing ekranoplanov supplemented the Japanese designers of the firm of "Kavasaki" (photo abcve). In 1963 to year they initiated the tests of the dyadic/two-place winged appaata, executed by the diagram of "trimarana" - during apron machine held on water three housing-floats. two of them tales are fastened on wing tips and played in flight the role of the washers, preventing the discharge of air from under wing. But in the third, central float was placed crew, and was bygone from behind was suspended the motcr of apparatus. This ekranplan passed a series summer and winter tests both on calm water and during certain sea rating and showed the maximum speed into 85 kilcmeters an hour. P The enumeration of experimental models and apparatuses it would be possible to continue it is further, if all they not tales are connected by their ultimate purpose - in their example the scientists and the designers attempted to trace ways to the resheiyu of basic to the poble cf producing the ekranoplanov among which to tsentral'ne place occupies the problem of start. Above has already been said that the "effect of the vliniya of screen" comes into action with complete output/efficiency cnly at sufficiently high speeds. Slechovatel'no, thus far apparatus not dignet these speeds, its housing first completely, and then partially will be submerged in water, experience/testing in this case so high a resistance as and housings vodoizmeshchayushchikh law courts. The calculations show

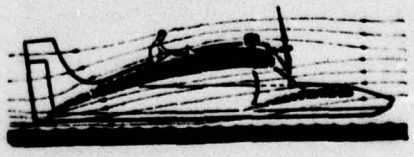
that for the overcoming of this resistance to ekranoplanam will be required by power, several times that exceed those, that are necessary for a cruise. The simplest solution to this problem lies in the fact that the engine plant of ekranoplana is divided by two is frequent - march, that ensures cruise, and starting. Since the latter will work only during comparatively short booster duration, in it can be used the engines with less reserves dolgovechnsti and, therefore, more light/lung and cheaper, than the cruising "motors" of ekranoplana (Fig. below). After the apparatus will leave to the cruise setting of slip, booster engines, it is natural, they will be turned off by i. they will be converted into the source of additional drag. This circumstance forces the designers to stop its selection of the type of starting "motors" at engines turbojet or turbofan: they do not have screw/propellers which after the engine shutdown create high resistance. But furthermore, these engines more easily to make those which are being removing inside ship.

Of the method of start with the aid of special engine plant, there is one disadvantage: in order that the expenditure of the fuel/propellant of tale minimum, acceleration/dispersal must be realized with high accelerations. There Are No Tekhicheskikh difficulties here, but to the passengers this start hardly will supply pleasure. Therefore the designers of ekranoplanov search for the today more comfortable and, it is natural, more economical methods of acceleration/dispersal, attempting in this case to utilize the different auxiliary devices, which make it possible for ekranoplanu to

build up housing above water earlier than it will achieve cruising skrostey flight.

A similar device it used in one of T. Kaaric its last/latter apparatuses (photo and diagram below to the left). Its machine with the arranged/located in front tractcr prcpellor it supplied with two supplementary wings cne of which bygone rotary. During acceleration/dispersal, this wing overlapped the slot between the upper supplementary and basic wings of ekranoplana, directing to under the latter part of the powerful flow frcm screw/propeller. In this case, the air cushion obrzovyvalas' under wing at comparatively low speeds, and resistance from contact with "runway" decreased. But after the apparatus of vysodil on the mode/ccnditions of ekranoplana, pivoting wing returned to horizontal position.

"pressurization/supercharging" from the screw/propellers of engines for the acceleration of the formation/education of the air cushion of ispol'zoali in its apparatus and the students of the Odessa institute of marine fleet (diagram to the right).



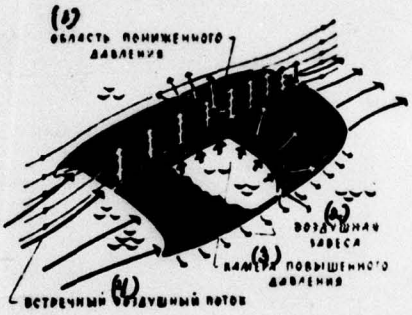
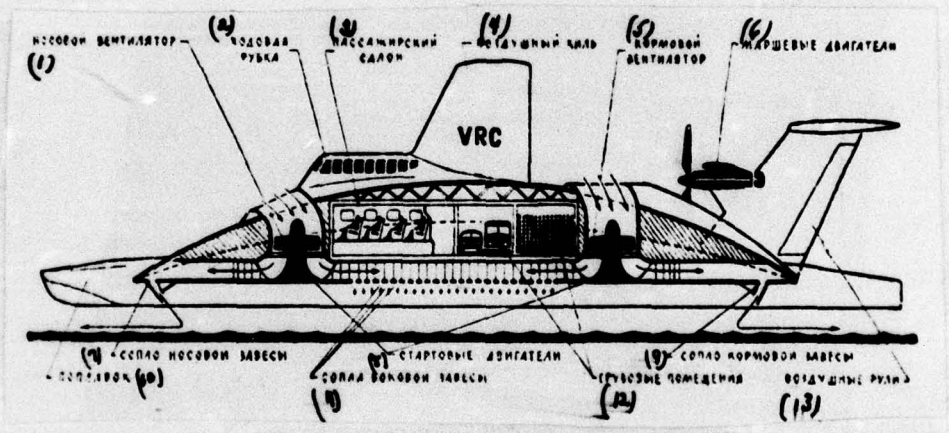


Diagram of the launch-3kranoplana, created by the group of the students of the Odessa institute of marine fleet under the management/manual of N. Sviridenko, V. Farvarshchuka and instructor of Yu. Budnitskiy.

Key: (1). Area of reduced pressures. (2). Air curtain. (3). Plenum. (4). Contrary air flow.

Transatlantic cargo and passenger ekranoplan of "Kolambiya": below - the general-arrangement diagram of apparatus; tc the right - the diagram of the flow of air flow about the housing-wing during motion under the conditions of ekranoplana.

Key: (1). Forepart/nose fan. (2). Code chopping. (3) /. Passenger salon. (4). Air fin. (5). Feed fan. (6). Sustainer engines. (7). the nozzle of the nosovoi of curtain. (8). Booster engines. (9). the nozzle of the kormovoi of curtain. (10). float.) (11). the nozzle of the bokovoi of curtain. (12). cargo pomeshchniya. (13). to vozdushne controls.



They created light/lung launch-3kranoplan which is driven by two motorcycle motors of K. Motory's 60 "are cut into" to the leading edge of the main wing of apparatus hearth which enters part of the air, compressed by screw/propellers. Apparatus weighs a total of 350 kilograms and easily slips abcve water at a distance several dozen centimeters.

Of all apparatuses examined above exists one common deficiency/lack: to the discharge cf air frcm under wing in them impede zhestike devices either in the form of flcats or in the form of endplates. In order to bring together the pcyeri of air to the minimum, these "enclosure/protections" they must be arrange/located as close as possible to the surface of water. But hence unavoidable "collisions" with the waves whose impact/shocks will disturb the comfort of the passengers. To avoid this it is possible only in one manner - to supply the underwing air chambers cf ekranoplanov with elastic "enclcsure/protection". And here the locks of many designers turn to the principle which found wide applicatien during the design of aerokhodov, to the principle of air curtain.

The tendency to organically connect up one machine the better/best qualities of aerokhodov and ekranoplanov is most vividly evident in an example of the transatlantic passenger apparatus of the "Kolambiya" whose project develop/processes the American firm of the "Viikl cf Riserch" (diagram below). Apparatus is performed by the diagram of catamaran snesushchim wing-shaped housing, from ends of which down depart narrow floats. housing-wing they pierce two

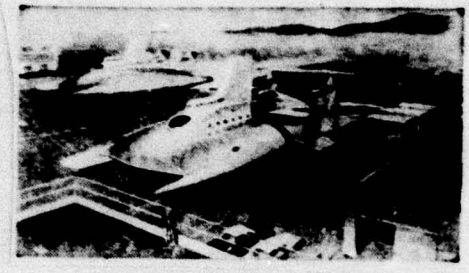
circular tunnels, in which are established/installed the fans, which feed air into circular slot cn the permetru cf hcusing. During start this air forms under ship the air cushion which heaves the floats above water. Then in "work" are included march propeller engines, and ship it begins motion similar to usual aerokhodu. In this case, the escape/ensuing of circular slot vzdukh plays the role of curtain to the preventing air lcsses from under wing.

With the acceleration/dispersal of apparatus, high-speed/velocity naporvstrechnogo air otoka gradually reaches this value, which makes it possible "to turn off" the forward section of the air zaesy. The rear part of the curtain is retained still fcr a while, providing the accelerated filling of air chamber, but the vmcment of output/yield to cruise setting is disconnected and it. After this the power of ventilator setting up is expended only on the pcdderzhniye of the lateral curtains, which prevent the discharge cf the compressed by wing air into sides, and apparatus it holds above water only the lift of its housing.

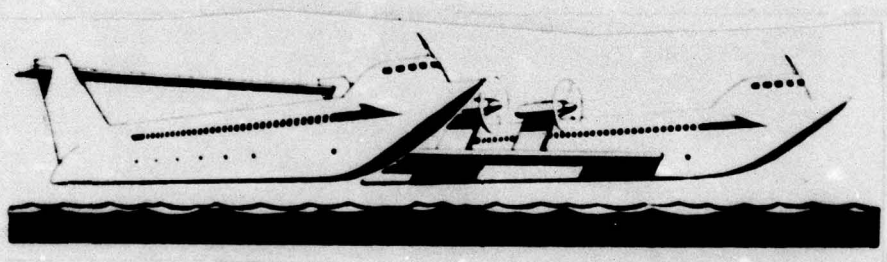
At first glance it can be shown that the ekranoplan of "Kolambiya", equipped with the special systen cf the formation/education of air cushion, differs little from its rivals - aerokhodov. On the matter itself this not thus. The power of ventilator setting up in this ship considerably less than it would be required for the osushchestveniya of the chistoaerokhodnogo principle of flight. in kreiserskcm mode/conditions use of the lateral curtains

makes it possible to reduce to a minimum of the loss of air and thereby substantial to increase the thickness of the vozduy of the poduki of odes by wing. and one additicral advantage of this diagram: because of that created by fans to the air cushicn of the ekranoplan of "Kolambiya" it will be able to emerge to dry land on inclined concrete flooring and to accomplish "landing" at those which were arrange/located sufficiently far frcm water cf lcading "moorages", where to it they will be are not terrible voleneniya at sea (Fig. on page of 40).

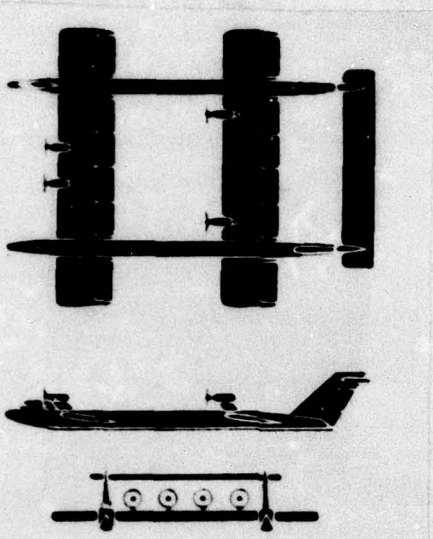
The Ekranoplan of "Kolambiya" is design/prcjected taking into account transportation 150 passengers or 36 tons of the load through the ocean with the speed of the 185- 220 cf kilometers of hour.



Ekranoplan of "Kolambiya" during loading of dry "moorage". On the seccnd plan/layout - "Kolambiya" it enters in pcrt on the concreted inclined flooring (project).



Above - transcontinental ekranolet "Veylandkraft" in flight above the ccean (project). [on the following pg] - the diagram another of the odnog of the version of the flying ktamarana of Veylanda (with the wings, which protrude for hull designs).



Apparatus by length about the 55 of meters and shirinoyu approximately the 24 of meter will weigh with load of approximately 100 tons and it will be able to move above water at the height/altitude of the 2.7 of meter. The specialists of the form of the "Viikl of Riserch" assume that the latter can be increased to the 3.6 of meter, if by it it were possible to carry out new principle of producing the lateral curtains. The engine plant of ekranoplana will consist of the 6 of turbcprop engines power on the 2270 of horsepower each, two of which will rotate the tractor propellors of apparatus, and four - the fans, which create cushion and curtains. In the construction of machine, will be used light aluminum alloys and fiberglass laminate. To Dal'nosst' the "obesposadochnogo" flight of ekranoplana - the 800 of kilometers.

, until now, the discussion concerned the ekranoplanakh in which the designers attempted to maximally utilize principle of air cushion and they abstract/removed to two remaining dynamic phenomena, causing the "effect of the effect of screen", only secondary role. On another way went Swiss engineer Kh. Veyyland, known abroad as designer of a series of high-speed/velocity machines on vzdushnoy cushion. As the basis of his new machine, he placed the phenomena of the disturbance/breakdown of tip vortexes and decrease in the downwash of the priizhenii of wing of screen, leading to a significant improvement in the aerodynamic characteristics.

The proposed by Veylandom intercontinental cargo and passenger apparatus of "Veylandkraft" is detayushchiy catamaran whose floats are

connected with two comparatively narrow and long wings (Fig. below). The already appearance of apparatus indicates that during its development the use of an air cushion was not provided for. This machine in essence is the low-flying aircraft and unlike winged apparatuses on air cushion can be called ekranoletom. In difference from aircraft it will heave approximately five times more the load.

Remembering about the failures, connected with the flight of aircraft of the Earth, Veyland focused special attention on the vprosy of stability and controllability. It is known that one of the disadvantages in the wing, which slides of screen, is the excessive "mobility" of the point of the application/appendix of resulting lift. During motion, this point can unexpectedly be displaced back/ago, forcing machine to peck by nose, and then just as unexpectedly it returns forward, and machine begins to be scored. Moreover all this occurs so rapidly which requires constant stress from pilot, his sverkhmgnovennogo interference.

Veyland attempted to solve this problem sufficiently original, after placing the wings of its machine one after another (diagram to the left). In this case, each wing seemingly had been the control device, which parries the errors of its "neighbor". If as a result of the displacement of the point of the application/appendix of resulting lift machine begins to nose down, then front/leading wing approaches a screen, and lift on it increases, forcing apparatus to return to normal position. But when machine is dumped on it zhvost, the "effect

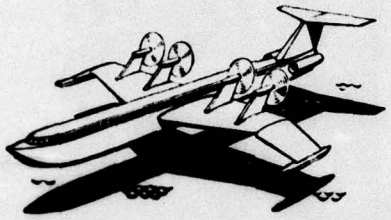
of the effect of screen" increases lift nz rear wing.

The heavy ekranoplan, proposed by Veylandcm, will weigh about the 1000 of tons and it will be be able to mcved above the ocean at the height/altitude of the 6 of meters with speed about the 185 of kilometers in hour, having aboard of the 3000 of the passengers. It is natural that thus far this machine exists only on drawing plates, its less brothers already attempted to leave into jcurney.

Experimental ekranolet the Lippish of X-112. On photo from bottom to top: apparatus during acceleration/dispersal; apparatus during motion under the conditions of ekranoplana; apparatus in flight.

Key: (1). Hypothetical. (2). the figure of ekranoleta. (3). transport.

(1) Гипотетический (2) рисунок экранолета. (3) транспортного



In 1963 to the year of Veyland concluded contract with the American firm "West It Kcust" for joint development and the construction of ekranoplana. Is first bygone is constructed the small model which was experience/tested in aeyaodinamicheskoy tube and in free-air conditions above hollow hangar. Model flew on straight line and in circle, retaining stability even with the gusts of "wind" which artificially were created in agar. When on the sex/floor of tale are established/installed the wooden racks, which imitate waves, model it did not reveal/detect the wish to follow their inequalities.

Soon after these tests the researchers constructed the experimental apparatus, controlled by pilot, outwardly similar to "large Veylandu". During March 1964 on the lake of Solton, in California, the machine completed its first and, unfortunately the last/latter flight. The motion-picture frames, removed from helicopter, show that first the machine easily was built up above water and sufficiently confidently flew above the screen at height/altitude about meter. But then the nose of machine unexpectedly began to tear upward, and it took off to height/altitude about the 7.5 of meter, that it is considerably more the rated altitude of flight. After the pilot discarded gas, apparatus fell to water it broke. The reasons for emergency establish/install could not, money of firm ended and thus far concerning the continuation of the investigations of this question there is no information.

The use of an "aircraft" principle of flight of screen, it is natural, could not but strike the designers against the idea of

producing apparatuses, capable of combining in itself the advantages of ekranoplana and aircraft. under the investigation of the problems of producing this universal machine in the USA it is occupied firm "Collins Reydio". It constructed and ccnducted the test series of the eksperimenta'nogo ekranoplana of the Lippish of X-112, capable brief time to fly similar to aircraft (photc tc the right). This apparatus and outwardly in by mngom reminds it saolet. At the ends of its omitted downward wing, are fastened the holding machine on water floats, which play simultaneously the rcle cf endplates. On these floats the apparatus accomplishes acceleraticn/dispersal, then emerges to mode/conditions ekranoplana and vzmyvae intc air. With the aid of this machine the scientists and the designers study the possibilities of designing of large apparatuses of this type, capable of accomplishing the overland flights of one water bassseyna in another or supply/delivering the passengers and the loads of the places, arrange/located in certain removal/distance frcm the basic water routes (Fig. below).

It is bygone to erroneous confirm that by its "reactivation" the idea of ekranoplanov is due only to the tendency to reduce the time of the transportation of the passengers and loads. The requirements for ccntemporary saving takovy,chto force to estimate in a new way pros and cons in the cargo vehicles. With ecm the speed becomes one of the basic indices of high cost-effectiveness/efficiency, kharakterzuya of its kind the high labor productivity of the cargo vehicles: the higher the speed, the more the voyages it can ccmplete apparatus for

one and the same time. From these positions of ekranoplany and ekranolety, capable of achieving the speeds cf the order of zhzhzhzh and even zhzhzhzh of kilometers in hour, are some of the pspektivnykh transport apparatuses.

Bibliography

1. С. Адасинский. ТРАНСПОРТНЫЕ МАШИНЫ НА ВОЗДУШНОЙ ПОДУШКЕ. Издательство «Наука». 1964 год.
2. Ю. Бенуа, В. Корсаков. СУДА НА ВОЗДУШНОЙ ПОДУШКЕ. Судпромгиз. 1962 год.
3. Е. Ружицкий. ВОЗДУШНЫЕ ВЕЗДЕХОДЫ. Издательство «Машиностроение». 1964 год.
4. Т. Стимсон. ЛЕТАЮЩИЙ КАТАМАРАН. «POPULAR MECHANICS» № [illegible], 1965 год.
5. А. Чернышев. КАТЕР ПЛЫВЕТ НАД МОРЕМ. «Юный техник» № 8, 1965 год.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER FTD-ID(RS)T-1432-76 ✓	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) EKRANOPLANS ARE WINGED SHIPS OF THE FUTURE		5. TYPE OF REPORT & PERIOD COVERED Translation
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) D. Pipko		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Foreign Technology Division Air Force Systems Command U. S. Air Force		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE 1966
		13. NUMBER OF PAGES 39
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

01

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

DISTRIBUTION LIST

DISTRIBUTION DIRECT TO RECIPIENT

ORGANIZATION		MICROFICHE
A205	DMATC	1
A210	DMAAC	2
B344	DIA/DS-4C	8
C043	USAMIIA	1
C509	BALLISTIC RES LABS	1
C510	AIR MOBILITY R&D LAB/FIO	1
C513	PICATINNY ARSENAL	1
C535	AVIATION SYS COMD	1
C557	USAIIC	1
C591	FSTC	5
C619	MIA REDSTONE	1
D008	NISC	1
H300	USAICE (USAREUR)	1
P005	ERDA	2
P055	CIA/CRS/ADD/SD	1
NAVORDSTA (50L)		1
NAVWPNSCEN (Code 121)		1
NASA/KSI		1
544 IES/RDPO		1
AFIT/LD		1

ORGANIZATION		MICROFICHE
E053	AF/INAKA	1
E017	AF/RDQLR-W	1
E404	AEDC	1
E408	AFWL	1
E410	ADTC	1
E413	ESD	2
	FTD	
	CCN	1
	ETID	3
	NIA/PHS	1
	NICD	5

PRECEDING PAGE BLANK-NOT FILMED